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### Section III. REMARKS

The pending claims in the application are claims 32-46, 48-53, 55-62 and 66-73.

#### Allowable Subject Matter

Claims 66-68 were found allowable. Applicants acknowledge same.

Claims 55, 56, 59, 60 and 70 were objected to as being dependent upon a rejected base claim, but were stated to be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim 55 has been rewritten herein in independent form including all of the limitations of claim 32, sequence (III). Allowance of amended claim 55 is respectfully requested.

Applicants acknowledge such indication of contingent allowability of the remaining claims 56, 59, 60 and 70, and respectfully request reconsideration of all pending claims 32-46, 48-53, 55-62 and 66-73 in light of the subsequent discussion.

#### Amendment of Claims 32, 33, 39-46, 48-53, 55-59, 61, 62, 69 and 70

Claims 32, 39-46, 55-59, 61, 62, 69 and 70 have been amended herein to change the term "processing chamber" to "semiconductor processing chamber." As such, all rejections relating to the use of the term "processing chamber" have been obviated.

Claim 32, sequence (III) (previously sequence (IV)), was further amended to include the limitations of claim 55, which was indicated to be contingently allowable by Examiner Wong herein.

Claims 48-53 have been amended to depend specifically from sequence (III) of claim 32.

Claim 61 has been amended to recite:

**"A method of generating chlorine trifluoride, for cleaning of a semiconductor processing chamber, said method comprising the steps of:**

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- (e) providing a fluorine gas source;
- (b) providing a chlorine gas source;
- (c) providing a diluent gas source;
- (d) mixing fluorine and chlorine gases in a mixing chamber communicatively connected with said fluorine gas source and said chlorine gas source;
- (e) supplying photoenergy to said mixing chamber from a photoenergy source to generate chlorine trifluoride in such mixing chamber;
- (f) flowing generated chlorine trifluoride into a holding chamber for storage until a pre-determined pressure threshold is reached;
- (g) supplying an inert gas from the diluent gas source connected with the holding chamber, to dilute the generated chlorine trifluoride; and
- (h) flowing diluted chlorine trifluoride from the holding chamber into the semiconductor processing chamber to effect cleaning therein."

Support for such amendment can be found in Figure 2 of the disclosure.

#### **Rejection of Claims and Traversal Thereof**

In the April 9, 2004 Office Action:

claims 32-35, 38, 41-42, 46, 48, 49, 51, 57, and 61 were rejected under 35 U.S.C. §102(b) as being anticipated by JP 2001-189273;

claims 32, 33, 38, 46 and 57 were rejected under 35 U.S.C. §102(a) as being anticipated by JP 2001-267241;

claims 36-37, 39-40, 43-45, 50, 52-53, 58 and 62 were rejected under 35 U.S.C. §103(a) as being unpatentable over JP 2001-189273; and

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claims 39-45, 48-53, 58 and 69 were rejected under 35 U.S.C. §103(a) as being unpatentable over JP 2001-267241.

These various rejections are traversed and reconsideration of the patentability of the claims is requested in light of the following remarks.

**35 U.S.C. §102(b) Rejection Based on JP 2001-189273**

In the April 9, 2004 Office Action, claims 32-35, 38, 41-42, 46, 48, 49, 51, 57 and 61 were rejected under 35 U.S.C. §102(b) as being anticipated by JP 2001-189273 (hereinafter "JP `273").

Applicants traverse such rejection.

JP `273 teaches the introduction of fluorine gas and chlorine gas into a preliminary reactor for the thermal or radiative generation of chlorine radicals, fluorine radicals, ClF molecules and ClF radicals ("the reactive species") therein, followed by passage of the generated reactive species from the preliminary reactor to a semiconductor processing chamber for cleaning therein. Thus, the reactive species are generated in the preliminary reactor before entering the semiconductor processing chamber.

With regards to claim 32, the Examiner stated that sequences (I) and (III) remain anticipated (see April 9, 2004 Office Action, pages 3 and 5). Applicants acknowledge the Examiner's implicit acknowledgement of the novelty of previously presented sequences (II) and (IV) over JP `273.

Sequence (III) of claim 32, as previously presented, has been excised herein and replaced with the content of previously presented sequence (IV), which was implicitly found to be novel over JP `273. Further, amended sequence (I) of claim 32 is not anticipated by JP `273.

With respect of sequence (I) of claim 32, the Examiner stated that:

"[s]equence I recites "a processing chamber. The processing chamber as presently claimed is not distinguished from the preliminary reaction vessel 5 disclosed in JP `273." (see April 9, 2004 Office Action, page 3, lines 18-19 through page 4, line 1)

Applicants have amended sequence (I) of claim 32 to recite, *inter alia*:

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“(i) flowing the fluorine gas and the halogen species from said respective sources therefor into a semiconductor processing chamber communicatively connected with said sources, without any intervening holdup of said fluorine gas and halogen species between the respective sources and the semiconductor processing chamber; and

(ii) generating the fluorine radicals and/or fluorine-containing interhalogen compounds by introducing external energy from an energy source into the semiconductor processing chamber containing the fluorine gas and the halogen species . . . .” (emphasis added)

JP `273 does not teach or suggest the introduction of fluorine gas and halogen species into the semiconductor processing chamber, without any intervening holdup of said gases between their respective gas sources and the semiconductor processing chamber, for generation of fluorine radicals and/or fluorine-containing interhalogen (hereinafter  $\text{XF}_n$ ) compounds therein.

Instead, JP `273 teaches the generation of reactive species in the preliminary reactor before passage of said reactive species to the semiconductor processing chamber. As such, sequence (I) of applicants' claimed invention is not anticipated by the JP `273 reference. Sequences (II) and (III) have already been found novel in light of JP `273.

Accordingly, applicants respectfully request withdrawal of the §102(b) rejection based on JP `273, of claim 32, and claims 33-35, 38, 41-42, 46, 48, 49, 51 and 57 directly dependent thereunder.

Claim 61 was also rejected as being anticipated by JP `273. According to the Examiner, JP `273 inherently teaches a method of generating chlorine trifluoride ( $\text{ClF}_3$ ).

Claim 61 has been amended herein to recite, *inter alia*:

“A method of generating chlorine trifluoride, for cleaning of a semiconductor processing chamber, said method comprising the steps of . . .

(c) providing a diluent gas source; . . .

(g) supplying an inert gas from the diluent gas source connected with the holding chamber, to dilute the generated chlorine trifluoride; and

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- (h) **flowing diluted chlorine trifluoride from the holding chamber into the semiconductor processing chamber to effect cleaning therein.”** (emphasis added)

Applicants' claim 61 requires the inclusion of a diluent gas into the holding chamber to dilute the chlorine trifluoride compounds generated therein.

In contrast, JP `273 discloses the use of an inert gas to purge the preliminary reactor following cleaning of the reaction chamber. As such, JP `273 does not teach or suggest applicants' claimed invention, wherein the diluent gas is supplied to the holding chamber “to dilute the generated chlorine trifluoride.”

It is noted that Examiner Wong found claim 66 novel and non-obvious over JP `273 because the claim recites that inert gas is supplied to the enclosure to “dilute the generated fluorine radicals and/or fluorine-containing interhalogen compounds.” Claim 61 correspondingly recites the same limitation and as such, should be acknowledged as allowable.

Accordingly, applicants respectfully request withdrawal of the § 102(b) rejection of claim 61 based on JP `273.

#### **35 U.S.C. §102(a) Rejection Based on JP 2001-267241**

In the April 9, 2004 Office Action, claims 32-33, 38, 46 and 57 were rejected under 35 U.S.C. §102(a) as being anticipated by JP 2001-267241 (hereinafter “JP `241”).

Applicants traverse such rejection.

JP `241 relates to the cleaning of a CVD processing chamber using a generated interhalogen reactive gas. To generate the interhalogen reactive gases, a mixture of gases are first introduced into a heated reactor to generate fluorine-containing interhalogen compounds, and these generated compounds are subsequently delivered to a semiconductor processing chamber for cleaning therein. Similar to JP `273, the reactive species are generated before entering the semiconductor processing chamber.

With regards to claim 32, the Examiner indicated that sequences (I) and (III) are anticipated by JP `241 (see April 9, 2004 Office Action, page 11). Applicants acknowledge the Examiner's implicit acknowledgement of the novelty of previously presented sequences (II) and (IV) over JP `241.

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As discussed hereinabove, sequence (III) of claim 32, as previously presented, has been excised herein and replaced with the content of previously presented sequence (IV), which was implicitly found to be novel over JP `241. Further, amended sequence (I) of claim 32 is not anticipated by JP `241.

JP `241 does not teach or suggest the introduction of fluorine gas and halogen species into the semiconductor processing chamber, without any intervening holdup of said gases between their respective gas sources and the processing chamber, for generation of fluorine radicals and/or fluorine-containing interhalogen (hereinafter  $\text{XF}_n$ ) compounds therein.

Instead, JP `241 teaches the generation of reactive species in the heated reactor before passage of said reactive species to the semiconductor processing chamber. As such, amended sequence (I) of applicants' claimed invention is not anticipated by the JP `241 reference. Sequences (II) and (III) have already been found novel in light of JP `241.

Accordingly, applicants respectfully request withdrawal of the §102(a) rejection based on JP `241, of claim 32, and claims 33, 38, 46 and 57 directly dependent thereunder.

#### **35 U.S.C. §103(a) Rejection Based on JP `273**

In the April 9, 2004 Office Action, claims 36-37, 39-40, 43-45, 50, 52-53, 58 and 62 were rejected under 35 U.S.C. §103(a) as being unpatentable over JP `273.

Applicants traverse such rejection.

As introduced hereinabove, JP `273 does not teach or suggest every limitation of applicants' claim 32, and claims 36-37, 39-40, 43-45, 50, 52-53, 55 and 58 that directly depend thereunder. For ease of reference, each characterizing sequence of claim 32 is distinguished from JP `273 hereinbelow.

#### **Sequence I**

As discussed in the previous Office Action, dated December 12, 2003, JP `273 disparages applicants' claimed invention, wherein the F radicals and/or  $\text{XF}_n$  compounds are generated within the semiconductor processing chamber. For example, JP `273 recites:

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"Moreover, when cleaning, when the source of plasma was prepared in a reaction chamber . . . it became a pollution source to the semiconductor wafer laid in the interior, and had become the cause of a fall of the reliability of the device." (see JP `273, , paragraph [0009]) (emphasis added)

As such, JP `273 actually teaches away from going in the direction of sequence (I) of applicants' claimed invention by stating that when the cleaning gases are generated within the processing chamber, they act as a pollution source, thereby discouraging one skilled in the art from going in the direction of applicants' claimed invention.

With reference to applicants' Response to the December 12, 2003 Office Action, the Examiner indicated:

"Applicants state that JP `273 actually teaches away from going in the direction of Sequence I of Applicants' claimed invention by stating that when the cleaning gases are generated within the processing chamber, they act as a pollution source, thereby discouraging one skilled in the art from going in the direction of Applicants' claimed invention.

In response, it appears that the cleaning gases generated within the processing chamber was a problem that was being solved by the JP `273 [sic] and not what the method of JP `273 was doing. That is why the method of JP `273 generated CIF in the preliminary reaction vessel 5 (=processing chamber) before introducing it into the reaction chamber 8 (=CVD system) by opening the bulb 18." (see April 9, 2004 Office Action, page 5, lines 2-11) (emphasis added)

The Examiner is respectfully reminded that prior art references must be considered in their entirety, for all that they entail. See, *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 220 U.S.P.Q. 303 (Fed. Cir. 1993), *cert. denied*, 469 U.S. 851 (1984).

The Examiner's statement that "it appears that the cleaning gases generated within the processing chamber was a problem that was being solved by the JP `273 [sic] and not what the JP `273 was doing," suggests that the Examiner only considers the improvement that the prior art reference teaches when evaluating claimed inventions for non-obviousness. This is not the standard – the Examiner must consider the reference as a whole, including statements relating to the problems being solved by the teachings of said reference.

Notably, the statement by the Examiner reproduced hereinabove supports applicants' teaching away argument. By the Examiner's own admission, the method of JP `273 relates to generating the fluorine-

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containing interhalogen compounds in a preliminary reaction vessel before passage to the semiconductor processing chamber because the JP `273 patentees recognized that the generation of cleaning gas within the semiconductor processing chamber "was a problem."

To reiterate, one skilled in the art reading JP `273 would not be motivated to generate fluorine-containing interhalogen compounds in the semiconductor processing chamber, as claimed by applicants herein, because JP `273 expressly states that "when the source of plasma was prepared in a reaction chamber . . . it became a pollution source to the semiconductor wafer laid in the interior."

Accordingly, JP `273 teaches away from sequence (I) of claim 32.

### Sequence II

Sequence (II) of applicants' claim 32 requires the inclusion of a diluent gas into the semiconductor processing chamber to dilute the F radicals and/or  $\text{XF}_n$  compounds contained therein.

In contrast, JP `273 only discloses the use of an inert gas to purge the preliminary reactor following cleaning of the reaction chamber. JP `273 does not motivate, teach or suggest one of ordinary skill in the art to modify the disclosure thereof in any way that would yield applicants' claimed invention. Purging following the cleaning of the reaction chamber, i.e., the JP `273 teaching, is NOT analogous to diluting the  $\text{XF}_n$  compounds that are generated within the semiconductor processing chamber for cleaning therein, i.e., applicants' claimed invention.

It is noted that the Examiner found claim 66, which recites that inert gas is supplied to the enclosure to "dilute the generated fluorine radicals and/or fluorine-containing interhalogen compounds," novel and non-obvious over JP `273. Sequence (II) of claim 32 correspondingly recites the same limitation.

Accordingly, sequence (II) of applicants' claim 32 is nonobvious over the JP `273 reference.

### Sequence III

Sequence (III) of applicants' claim 32 has been amended to include the limitations of claim 55, which Examiner Wong found to be non-obvious over the prior art of record because the prior art does not teach or suggest "monitoring and controlling the flow rate of the formed fluorine radicals and/or fluorine-



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containing interhalogen compounds from the holding chamber into the semiconductor processing chamber" (see April 9, 2004 Office Action, page 17, lines 11-14).

As such, by the Examiner's own admission, JP `273 does not teach or suggest every limitation of presently pending Sequence (III) of applicants' claim 32.

Accordingly, sequence (III) of applicants' claim 32 is nonobvious over the JP `273 reference.

Therefore, considered *in toto*, amended claim 32, and all claims depending thereunder, are nonobvious over the JP `273 reference.

Applicants respectfully request withdrawal of the §103(a) rejection of claims 36-37, 39-40, 43-45, 50, 52-53, 55 and 58 based on JP `273.

Claim 62 was also rejected as being unpatentable over JP `273.

According to the Examiner:

"claim 62 recites "flowing fluorine gas and chlorine gas from said sources into a processing chamber." The processing chamber as presently claimed is not distinguished from the preliminary vessel 5 disclosed by JP `273." (see April 9, 2004 Office Action, page 9, lines 11-13)

Claim 62 has been amended herein to recite, *inter alia*:

**"A method for generating chlorine trifluoride, comprising the steps of ...**

**flowing fluorine gas and chlorine gas from said gas sources into a semiconductor processing chamber; and**

**supplying photoenergy to said processing chamber from a photoenergy source to facilitate generation of chlorine trifluoride in such semiconductor processing chamber."** (emphasis added)

As discussed hereinabove, JP `273 teaches away from flowing the unreacted gases directly into the semiconductor processing chamber for reaction therein.

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As such, applicants respectfully request withdrawal of the rejection of claim 62 under 35 U.S.C. §103(a) over JP `273.

**35 U.S.C. §103(a) Rejection Based on JP `241**

In the April 9, 2004 Office Action, claims 39-45, 48-53 and 58 were rejected under 35 U.S.C. §103(a) as being unpatentable over JP `241.

Applicants traverse such rejection.

As introduced hereinabove, JP `241 does not teach or suggest every limitation of applicants' claim 32, and claims 39-45, 48-53 and 58 directly dependent thereunder. For ease of reference, each characterizing sequence of claim 32 is distinguished from JP `241 hereinbelow.

**Sequence I**

According to the Examiner, JP `241 "does not teach wherein the fluorine gas and the halogen species are separately flowed into the processing chamber and mixed therein to form the fluorine radicals and/or fluorine-containing interhalogen compounds." However,

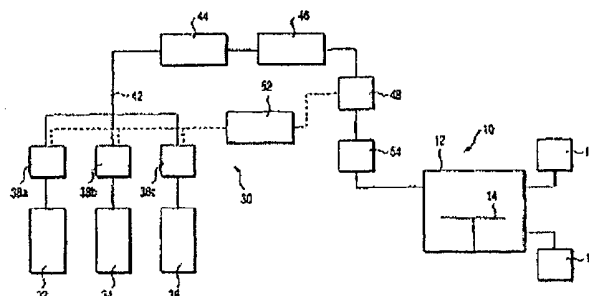
"the invention as a whole would have been obvious to one having ordinary skill in the art . . . to have modified the method of JP `241 with [sic] wherein the fluorine gas and the halogen species are separately flowed into the processing chamber and mixed therein to form the fluorine radicals and/or fluorine-containing interhalogen compounds because the transpositioning of varying steps, or varying the details of a process, as by adding a step or splitting one step into two does not avoid obviousness where the processes are substantially identical or equivalent in terms of function, manner and result." (see April 9, 2004 Office Action, page 12, lines 16-18 through page 13, lines 1-5)

Applicants vigorously disagree.

JP `241 generally relates to the cleaning of a CVD processing chamber using an interhalogen reactive gas generated *in situ*. Fluorine gas, a halogen gas other than fluorine, and an inert gas are mixed in a heated reactor 44 to generate the interhalogen species. Thereafter, the generated interhalogen species are cooled in a condenser 46, the species are quantitated in an analyzer 48, and the generated interhalogen species

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are introduced to the CVD processing chamber 12 for cleaning therein. For ease of reference, an embodiment of JP '241 is reproduced below.



The object of JP '241 includes:

"Thus, in the present condition, procedure, such as adding the manufacture process of a raw gas separately, is needed to adjust the gas constituents according to processing." (see JP '241, English translation, paragraph [0005])

Towards that end, JP '241 requires the analysis of the generated interhalogen species in the analyzer 48, which quantitates the interhalogen gas species generated in the heated reactor. The measurement results obtained in the analyzer are transmitted to a controller 52, which communicates with mass flow controllers 38a, 38b and 38c to adjust the volume ratio of fluorine gas, halogen gas (other than fluorine) and inert gas introduced into the heated reactor 44. The inclusion of the analyzer in the apparatus of JP '241 allows the operator to adjust the quantity of interhalogen gases introduced into the CVD processing chamber.<sup>1</sup>

Contrary to the Examiner's contention, it would NOT have been obvious to one skilled in the art "to have modified the method of JP '241 with [sic] wherein the fluorine gas and the halogen species are separately flowed into the processing chamber and mixed therein." Comparing JP '241 with applicants' claimed invention, the introduction of the reactant gases directly into the semiconductor processing chamber, as claimed by applicants' herein, is NOT a simple "transpositioning" of the JP '241 teaching.

<sup>1</sup> See, JP '241, English translation, paragraph [0035] ("Especially, according to the equipments 30 and 60, such as this, composition of generation gas can be adjusted according to processing by setting the volume ratio of the chlorine gas in mixed gas, fluorine gas, and inert gas as any value in the above-mentioned range . . .").

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Instead, the condensing and analysis steps of JP `241 process would have to be removed, however, the removal of the analysis step from the JP `241 apparatus is directly contrary to the teaching of JP `241, which expressly states the importance of making adjustments upstream, e.g., at the pure gas sources, so as to modify the concentration of interhalogen gases introduced into the CVD processing chamber. Clearly, the removal of the analyzer 46 from the apparatus of JP `241 would render JP `241, as hypothesized by the Examiner, unsatisfactory for its intended purpose. As such, a *prima facie* case of obviousness has not been established. See, *In re Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984).

Accordingly, sequence (I) of applicants' claim 32 is nonobvious over the JP `241 reference.

#### Sequence II

Sequence (II) of applicants' claim 32 requires the inclusion of a diluent gas into the semiconductor processing chamber to dilute the F radicals and/or  $\text{XF}_n$  compounds contained therein.

In contrast, JP `241 discloses the addition of an inert gas to the heated reactor to act as a dilution gas or carrier gas (see JP `241, English translation, paragraph [0021]).

JP `241 does not motivate one of ordinary skill in the art to modify the disclosure thereof in any way that would yield applicants' claimed invention.

It is noted that the Examiner found claim 66, which recites that inert gas is supplied to the enclosure to "dilute the generated fluorine radicals and/or fluorine-containing interhalogen compounds," novel and non-obvious over JP `241. Sequence (II) of claim 32 correspondingly recites the same limitation.

Accordingly, sequence (II) of applicants' claim 32 is nonobvious over the JP `241 reference.

#### Sequence III

As introduced hereinabove, sequence (III) of applicants' claim 32 has been amended to include the limitations of claim 55, which Examiner Wong found non-obvious over the prior art of record.

As such, by the Examiner's own admission, sequence (III) of applicants' claim 32 is nonobvious over the JP `241 reference.

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Therefore, considered *in toto*, applicants' claim 32, and claims 38-45, 48-53 and 58 dependent thereunder, are nonobvious over the JP `241 reference.

Applicants respectfully request withdrawal of the §103(a) rejection of claims 38-45, 48-53 and 58 based on JP `241.

Claim 69 was also rejected as being unpatentable over JP `241.

The Examiner indicated that sequence (II) of claim 69 was obvious in view of JP `241 (see April 9, 2004 Office Action, page 16). Sequence (II) of claim 69 has been excised herein.

Claim 69 has been further amended herein, to replace the term "processing chamber" with the term "semiconductor processing chamber."

JP `241 does not motivate, teach or suggest the introduction of the diluent gas at the semiconductor processing chamber, as claimed herein by applicants.

Instead, JP `241 teaches the introduction of a mixture of gases, including an inert gas, into a heated reactor to generate fluorine-containing interhalogen compounds, wherein the heated reactor is upstream of the semiconductor processing chamber.

Accordingly, applicants respectfully request withdrawal of the §103(a) rejection of claim 69 based on JP `241.

#### **Fees Payable for Added Claims 71-73**

Three (3) dependent claims have been added herein and one (1) dependent claim has been converted into an independent claim. However, a total of 34 claims, four (4) of which are independent, have been cancelled herein. As such, no added claims fee is due.

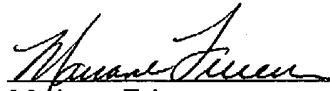
Authorization is hereby given to charge any deficiency in applicable fees for this response to Deposit Account Number 08-3284 of Intellectual Property/Technology Law.

#### **CONCLUSION**

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Based on the amendments made herein and the foregoing remarks, claims 32-46, 48-53, 55-62 and 66-73 are now in form and condition for allowance. Examiner Wong therefore is respectfully requested to reconsider and allow such claims.

Respectfully submitted,



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## APPENDIX A

## Replacement Sheet

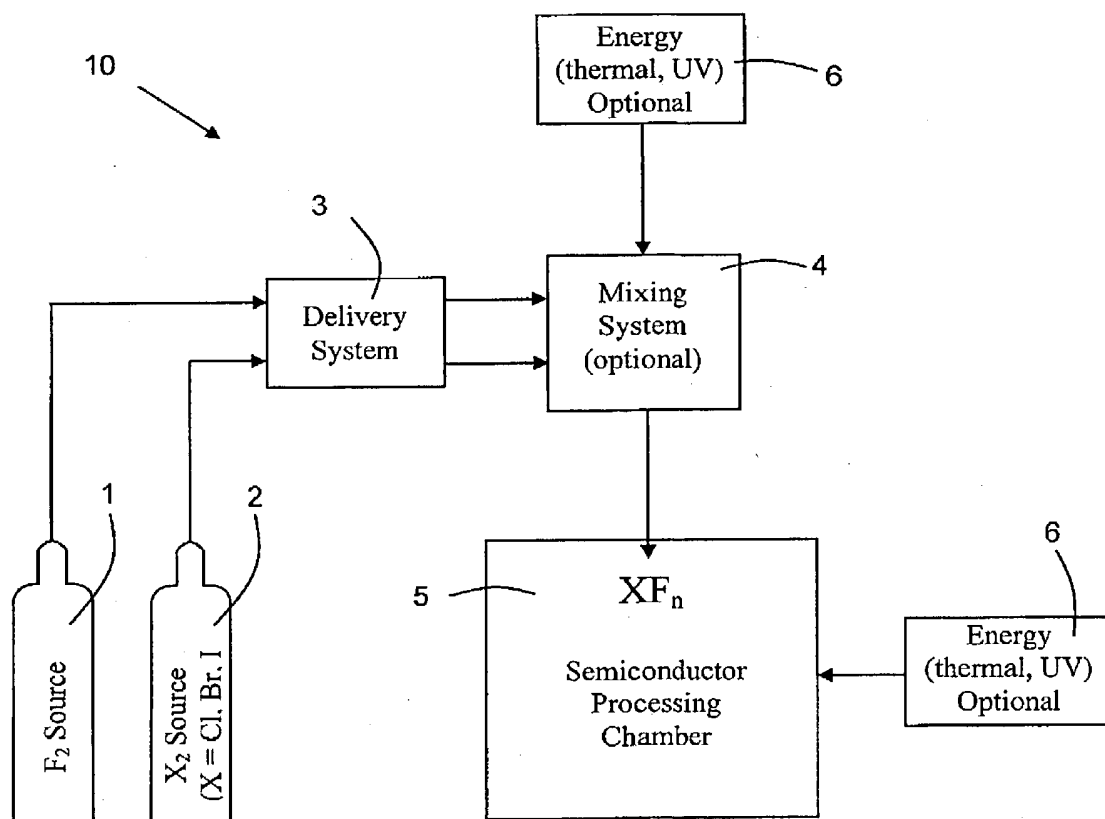


FIGURE 1



## Replacement Sheet

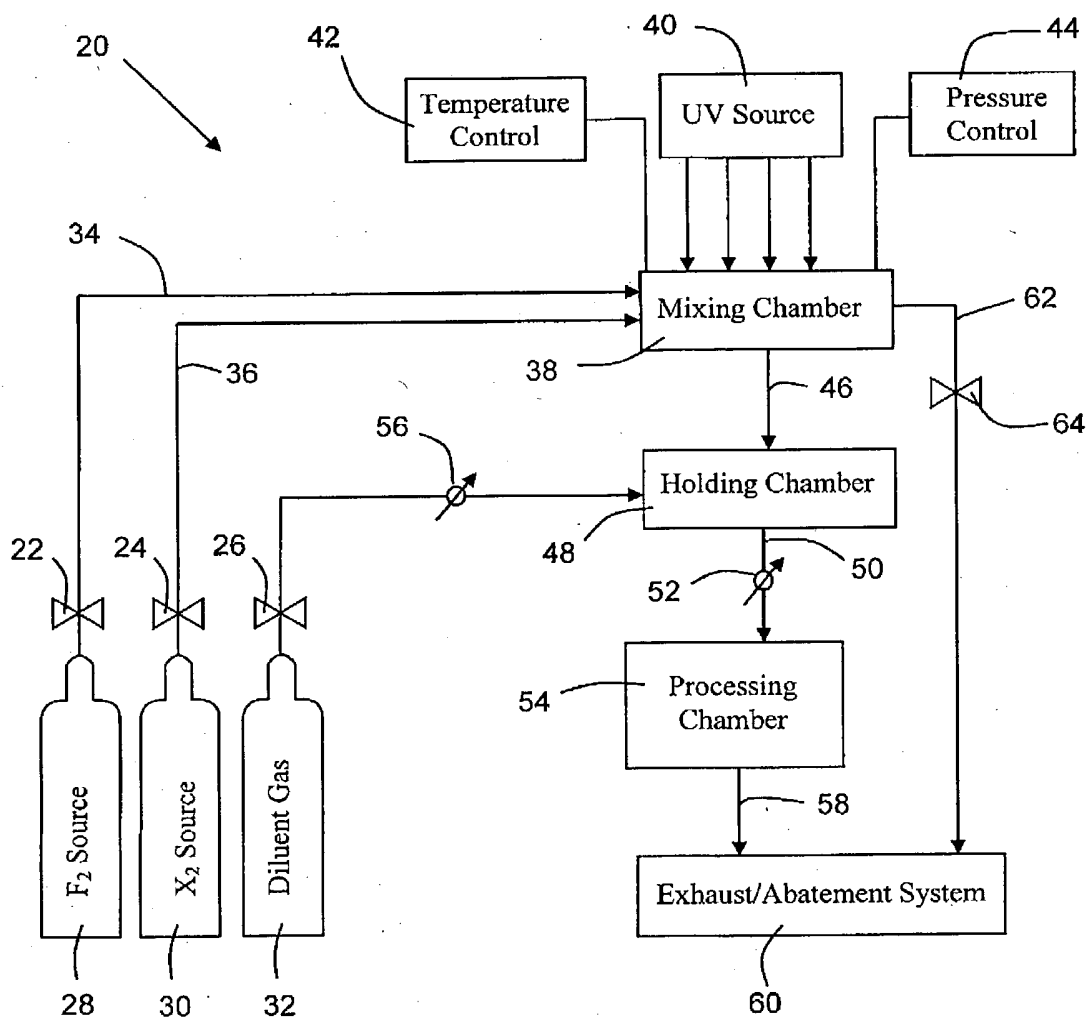


FIGURE 2